

MODIS

Emergency Back-up System

Requirements Specification



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Change Notice 4

MODIS Emergency Back-up System Requirements Specification

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Change Record Page

This document is baselined and has been placed under Configuration Control. Any changes to this document will need the approval of the Configuration Control Board.

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MODIS Emergency Back-up System Requirements Specification

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MODIS Emergency Back-up System Requirements Specification

1. SCOPE

This document describes the Moderate Resolution Imaging Spectroradiometer (MODIS) Emergency Back-up System (MEBS). The system uses Version 1 and Version 2 science software delivered to the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (GDAAC) to run within the MEBS. This document also describes the changes necessary for MEBS to run at the Team Leader Computing Facility (TLCF) for the purpose of discussion and reference. The requirements and the associated interfaces shown in Figure 1-1 will be defined in Sections 3 and 4.

1.1 Objectives

The objectives of this requirements specification have been modified as defined in An Emergency Backup System to Support MODIS Algorithm Validation for Six Months Following AM-1 Launch [Reference 1] to be more in scope with current resources. MEBS should:

1. Provide a timely, stable processing environment to support the pre-launch development, test and performance optimization of MODIS science algorithms
2. Provide sufficient data processing and distribution to enable the MODIS Science Team to test, debug, and validate the science algorithms in the initial post-launch operations period.

1.2 System Overview

A conceptual design of the MEBS is shown in Figure 1-1.

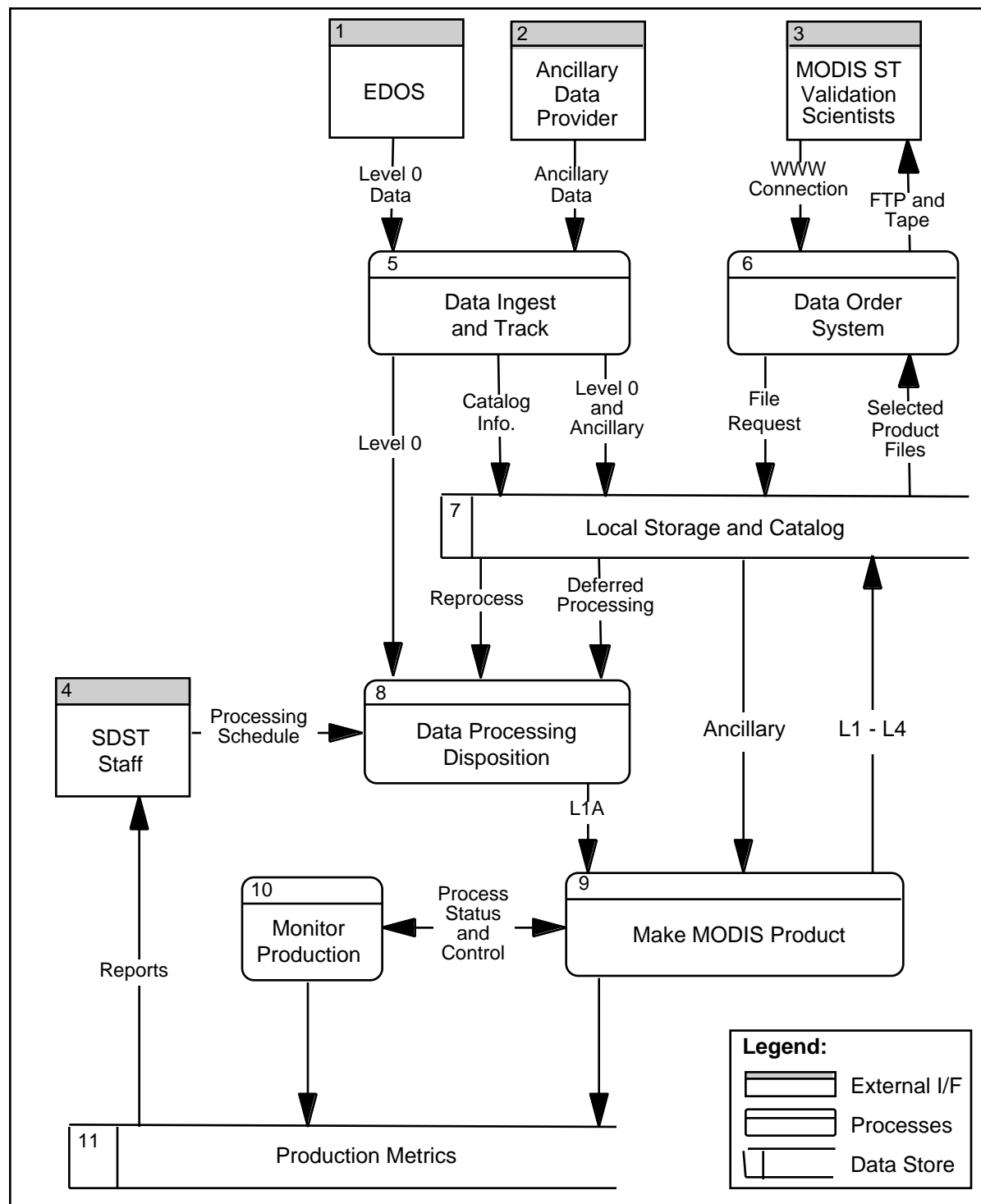


Figure 1-1. MEBS Data Flow Diagram

2. REFERENCES

1. An Emergency Backup System to support MODIS Algorithm Validation for Six Months Following AM-1 Launch; July 1997.
2. MODIS Science Data Processing Software Version 1 System Description SDST-065
3. MODIS-EOS Data and Operations Systems (EDOS) Interface Control Document (ICD) - to be written.
4. MODIS-External Ancillary Data Providers Interface Control Document - to be written.
5. TLCF/Miami Oceans Team Agreement - to be written.
6. MODIS Characterization Support Team Interface Control Document - to be written.
7. MODIS Science Data Processing Software Version 2 System Description - to be written.

3. SYSTEM REQUIREMENTS

The requirements discussed below are organized such that each section corresponds to an entity from Figure 1-1.

MEBS-3.0-1: The MEBS system shall allocate separate resources to support testing.

MEBS-3.0-2: The MEBS system shall allocate separate resources to support Science Team Members, MODIS Characterization Support Team (MCST), and Science Data Support Team (SDST).

3.1 Data Ingest and Track

The MEBS will receive data from EDOS. The specification and details associated with this data will be described in a separate document [Reference 3].

MEBS-3.1-1: MEBS will receive and ingest the MODIS Level 0 data in accordance with MODIS-EDOS interface.

MEBS-3.1-1.1: This will be an automated process.

MEBS-3.1-1.2: This data will be archived for later retrieval according to:

- Date/Time.
- File name.

MEBS-3.1-2: MEBS will receive and ingest the ancillary data in accordance with MEBS Ancillary Data Providers ICD [Reference 4].

MEBS-3.1-2.1: The data to be acquired include:

- National Meteorological Center (NMC).
- Total Ozone Mapping Spectrometer (TOMS) ozone.
- Data Assimilation Office (DAO).

MEBS-3.1-2.2: This data will be staged for all necessary Product Generation Executives (PGEs).

MEBS-3.1-2.3: This will be an automated process.

MEBS-3.1-2.4: This data will be archived for later retrieval according to:

- Date/Time.
- File name.
- File Type.

3.2 Data Processing Disposition

The production, archival, and distribution of the MODIS science data products will be constrained by the resources [storage and Central Processing Unit (CPU)] available for

processing. Consequently the following requirements are placed on the system to ensure stability and a coherent production schedule.

MEBS-3.2-1 Available granules of the product type's bounding box and start time intersect a high priority region will be processed before available granules that do not intersect a high priority region.

- High priority regions are defined by a start time, a stop time, a latitude-longitude bounding box, and a product type.

MEBS-3.2-2: Incoming data shall be processed according to the following:

MEBS-3.2-2.1: Files will be archived upon arrival at the TLCF.

MEBS-3.2-2.2: Processing shall be done according to MEBS-3.2-1 and MEBS-3.3-1.

MEBS-3.2-3 MEBS shall retrieve deferred granules from storage automatically when allocated CPU resources are available.

- This capability is to work unattended for up to 24 hours.

3.3 Make MODIS Products

Each product generated by MEBS will have its own internal requirements which are listed below.

MEBS-3.3-1 MEBS shall be capable of running the latest version of all MODIS software and producing all of the MODIS products. In addition, the following derived requirements discuss the processing scenarios representative of the existing MODIS production system in accordance with the MODIS Science Data Processing System Version 2 System Description [Reference 7].

MEBS-3.3-1.1: MEBS shall process one Level 0 file as input and a number of Level 1A (L1A) granule products as output **(One-to-many granules)**.

MEBS-3.3-1.2: MEBS shall process one or more products corresponding to a single granule as input and one or more products for the same granule as output **(Granule-based processing)**.

MEBS-3.3-1.3: MEBS shall select for processing ancillary files which bracket the granule time **(Dynamic ancillary input files)**.

MEBS-3.3-1.4: MEBS shall select and process several Level 1 (L1) or Level 2 (L2) product granules of a specified type which overlap with a specific tile as input, and produce a single tile product as output **(L2G processing)**.

- MEBS-3.3.-1.5: MEBS shall process one or more L2 products to produce a Level 3 (L3) product (either resampled or composited onto a geographic grid) **(L2 to L3)**.
- MEBS-3.3-1.6: MEBS shall process multiple L2G or L3 products aggregated temporally and/or spatially to produce a single L3 product of the same type **(L3 Aggregation)**.
- MEBS-3.3-1.7: MEBS shall process multiple L2G or L3 products aggregated temporally and/or spatially to produce a single L3 product of different type(s) or a L4 product where appropriate, **(L3 and L4 Modeling)**.
- MEBS-3.3-1.8: MEBS shall resample and/or reproject one or more L3 products to produce the same product with a different projection or resolution **(L3 Resampling)**.
- MEBS-3.3-1.9: MEBS shall be capable of updating or appending to an existing product or file **(File/Product Updating)**.
- MEBS-3.3-1.10: MEBS shall process a variation of the L2 scenario, wherein a L2 process requires as input a L3 product from the same time period (along with other L1 and/or L2 products) **(L3 Input to L2)**.
- MEBS-3.3-1.11: MEBS shall process a variation on L3 aggregation, in which a three-week interim product is created and combined with a daily interim product to produce the final daily product; this is used for both Ocean Color and Sea Surface Temperature processing **(L3 Reference File)**.
- MEBS-3.3-1.12: MEBS shall select and process MODIS input data products for a time interval extending beyond the nominal granule interval in order to produce a single granule as output **(Granule-based processing with extended time range)**.
- MEBS-3.3-1.13: MEBS shall support the Ocean data day production rule in its processing of interim Ocean products leading to the production of L3 Ocean products.

MEBS-3.3-2: MEBS shall produce L1A files subsampled at every fifth pixel and fifth scan line for the Miami Oceans Team in accordance with the TLCF/Miami Oceans Team Agreement [Reference 5].

3.4 Monitor Production

MEBS-3.4-1: An operator shall be able to monitor the status of any stream as it executes.

MEBS-3.4-2: An operator shall be able to monitor the overall status of MEBS.

MEBS-3.4-3: Each PGE started within MEBS shall be logged with its start time and data set name.

MEBS-3.4-4: Each PGE started within MEBS shall be logged with its end time, data set name, CPU resources utilized, final status code, and associated location of its QA and Log files.

MEBS-3.4-5: MEBS shall monitor available disk space and CPU resources.

3.5 Production Metrics

MEBS-3.5-1: MEBS shall report summary information consistent with information gathered in MEBS-3.4-3, 3.4-4, and 3.4-5 on products generated.

3.6 Data Ordering System

The prototype of the MEBS Data Ordering System (MEBDOS) can be found on Universal Resource Locator (URL):

<http://ftpwww.gsfc.nasa.gov/MODIS/SDST/mebs/MODIS1.html>

MEBS-3.6-1: MEBS shall support browsing of the data archives by external users through a simple interface.

MEBS-3.6-1.1: The MEBDOS shall display a table of all product types currently available in the archive according to specific queries based on the Product Catalog.

MEBS-3.6-2: Distribution to the MODIS Science Team will be accomplished by ftp from the on-line data storage or by shipping tapes to the end user.

MEBS-3.6-2.1: The MEBDOS shall have a direct link to the ftp site for downloading on-line data which have been identified through browsing.

MEBS-3.6-2.2: The MEBDOS shall monitor available disk space, processing capabilities, and network connections to impose limits on ftp retrievals.

MEBS-3.6-2.3: The MEBDOS shall support the entry of user requests to stage off-line data for downloading.

MEBS-3.6-3: The Browse images shall be produced for Land Surface Temperature, Ocean Color, and Cloud Mask. MEBS-3.6-3.1: The Browse image of each chosen product will be made according to the generation frequency of the products.

MEBS-3.6-3.2: Thumbnail images will be made from the Browse images at a lower resolution.

MEBS-3.6-4: MEBDOS will interface with a database to track information about registered users of the system. The information will include:

- Name,
- Shipping address,
- Email address,
- Phone number.

MEBS-3.6-5: MEBDOS shall track orders placed to include:

- Who placed the order,
- File names,
- Transmission media,
- Directory where stored,
- Expiration date,
- Status information.

MEBS-3.6-6: MEBDOS shall notify users via email when their orders are ready for distribution.

MEBS-3.6-7: MEBDOS shall fulfill standing orders for explicit products referenced in an ICD, limited by available resources.

3.7 Local Storage and Catalog

MEBS-3.7-1: MEBS shall maintain a Product Catalog which contains the following metadata fields:

- Product Identification,
- Data set name,
- Time range (of acquisition),
- Processing Level,
- Longitude and Latitude bounding box,
- File size,
- On-line status,
- Location of Browse image,
- Location of Browse thumbnail,

- Day/Night flag,
- Known serious flaws flag,
- Known serious flaws description.

MEBS-3.7-2: MEBS operations personnel shall be able to stage and destage data sets from the tape archive according to the file name of the data set or the metadata fields defined in 3.7-1.

MEBS-3.7-3: MEBS shall use the Product Catalog to find the names of data sets which fit the selection criteria provided by the end user or the system operations staff through the Browse and Order function of the operator's interface for staging/destaging.

MEBS-3.7-4: MEBS operations personnel shall have the capability of updating any of the fields in the product catalog manually using SQL statements.

MEBS-3.7-5: MEBS shall store additional files generated in production in the archive and the product catalog. The list of additional files to be stored will be added in a future release of this document.

- Product catalog entries can be limited to time and geographic location based on the ranges of their associated normal products.

MEBS-3.7-6: MEBS archive shall have an entry in the Product Catalog for each data set stored.

MEBS-3.7-7: MEBS shall allow multiple versions of the same product for the same granule or tile in the archive.

MEBS-3.7-8: MEBS shall store QA files generated during production.

MEBS-3.7-8.1: These products will be cataloged.

MEBS-3.7-8.2: These products will be stored for seven days in accordance with the TLCF/Miami Oceans Team Agreement [Reference 5].

MEBS-3.7-9: The corresponding entry in the Product catalog shall be deleted when a data set is deleted from the tape archive.

MEBS-3.7-10: MEBS shall allow updates of granule level metadata without reprocessing.

4. INTERFACE REQUIREMENTS

4.1 EOS Data and Operations Systems/Team Leader Computing Facility

This interface defines the interaction between the EDOS and MEBS for ingest. The MODIS- EOS Data and Operations Systems ICD [Reference 3] will provide the details of this interface.

4.2 External Ancillary Data Providers /Team Leader Computing Facility

This interface defines the interaction between the External Ancillary Data Providers and MEBS for ingest. It will be crucial to have agreements in place that specify this interface in detail that will provide all the necessary and sufficient information required for the MEBS to begin production. In addition this interface definition will be in place early. the MODIS-External Ancillary Data Providers ICD [Reference 4] will provide the details of this interface.

4.3 MODIS Science Team and Quality Assurance Validation Scientists

MEBS-4.3-1: Science Team Members and Validation Scientists shall interface with MEBS via the Browse and Order function.

MEBS-4.3-1.1: Total data retrieval volumes at any time may be limited by available resources.

MEBS-4.3-1.2: Files will remain available for retrieval for three days beyond the day they are produced.

MEBS-4.3-2: Science Team Members who require additional support from MEBS are required to submit an ICD to the MEBS personnel.

5. SYSTEM QUALIFICATION REQUIREMENTS

MEBS-5.1: MEBS shall go through three stages of qualification during V1 software integration, based on arguments previously described in An Emergency Backup System to support MODIS Algorithm Validation for Six Months Following AM-1 Launch [Reference 1]. For V2 software, qualification begins where V1 software left off. The information in Table 5-1 is based on the V1 System Description.

MEBS-5.1-1: "Hour in the Life" - Demonstrate V1 L1 and L2 processes with an orbit's worth of data to verify MEBS 3.3-1.1 and MEBS 3.3-1.2.

MEBS-5.1-2: "Day in the Life" - Generate products requiring data spanning a day.

MEBS-5.1-3: "Week in the Life" - Generate MODIS 8-day products and demonstrate capabilities to support browse product generation and data ordering.

MEBS-5.1-4: "End-to-End Test" - Generate all products requiring data from one to 32 days.

Table 5-1. Stages of MEBS Qualification

Stage	Category	PGE Numbers
"Hour in the Life"	Atmosphere	1, 2, 3, 4, 5, 6
	Land	1, 2, 3, 4, 5, 7, 8, 11
	Ocean	1, 2, 3, 9, 10, 17, 19
"Day in the Life"	Atmosphere	1, 2, 3, 4, 5, 6
	Land	1, 2, 3, 4, 5, 7, 8, 11, 12A, 12B, 13A, 13B, 13C, 14, 15, 16, 21, 33, 43, 44
	Oceans	1, 2, 3, 9, 10, 17, 19, 20
"End-to-End Test"	Atmosphere	1, 2, 3, 4, 5, 6
	Land	1, 2, 3, 4, 5, 7, 8, 11, 22, 23, 25, 26, 27, 28, 30, 34, 37, 40, 41, 45, 47
	Ocean	1, 2, 3, 9, 10, 17, 18, 19, 20, 49, 50, 51, 53, 54

MEBS-5.2: MEBS shall demonstrate reprocessing staging and de-staging.

MEBS-5.2.1: Data will be staged manually and automatically according to Product and Time Range.

MEBS-5.2.2: Data will be de-staged manually and automatically according to Product and its used status.

- MEBS-5.3: MEBS shall demonstrate deferred process staging and de-staging.
- MEBS-5.3.1: Data will be staged according to Product and Time Range.
- MEBS-5.3.2: Data will be de-staged according to Product and its used status.
- MEBS-5.4: MEBS shall demonstrate the limits on size and bandwidth during data retrievals that we will set during operations.
- MEBS-5.5: MEBS shall demonstrate that the system can process data only in regions of interest (as defined in 3.2-1).
- MEBS-5.6: MEBS shall demonstrate that the system can report production metrics.
- MEBS-5.7: MEBS shall demonstrate product versioning for granules and tiles.
- MEBS-5.8: MEBS shall demonstrate data selection based on all fields in the product catalog.
- MEBS-5.9: MEBS shall demonstrate ancillary data selection based on fields in its catalog.
- MEBS-5.10: MEBS shall demonstrate that it can support concurrent production on three computers.
- MEBS-5.11: MEBS shall demonstrate production on Silicon Graphics Incorporated (SGI) Power Challenge and SGI Origins 2000 computer systems with multiple processors.
- MEBS-5.12: MEBS shall demonstrate that the operator interface and schedules can handle a processing load of 1,000 jobs per day.

6. CONSTRAINTS

The following are the MEBS constraints.

1. MEBS will not provide 1X processing. It can not produce all products globally for all times. Choices must be made to limit some combination of the products produced, the geographic areas where products are produced, or the time intervals for which products are produced.
2. MEBS can not support the entire science community. MEBS can only support data requests from the MODIS Science Team, MODIS Validation Scientists, MODIS QA Scientists, and their representatives.
3. MEBS is not a long time service. The MEBS will not be needed for new production when Earth Observing System Data and Information System (EOSDIS) Core System (ECS) B.0 production is available in the Distributed Active Archive Centers (DAACs). This is nominally six months after launch.
4. MEBS will not have a text based interface for data ordering.
5. MEBS data transfers will be limited to FTP over currently available network interfaces, or Digital Linear Tape (DLT) or 8mm tapes shipped through the mail or parcel services.
6. MEBS resource limits (both on-line storage and operator availability) will limit the total volume of data that can be ordered in a one week period. The limit itself is not yet known.
7. MEBS will not have any data or browse information from other instruments such as MISR, ASTER, etc.
8. MEBS will use the current SeaWifs scheduler.
9. MEBS will use existing Ampex 812 tape libraries for near-line storage.
10. MEBS will use QuickRestore COTS software to manage file staging and destaging from the Ampex libraries.
11. MEBS will not support the following general services on products: subsampling, subsetting by parameter or geographic region, and data subscriptions through the World Wide Web ordering interface. For specific products a subset of the above services may be provided depending on software development resources. An agreement to provide these services must be negotiated with the Science Data Support Team (SDST) Staff and documented with an ICD.
12. MEBS operations personnel will have the capability of deleting tapes from the tape archive.
13. MEBS will plan resource requirements according to Table 6-1 which reflects resource requirements as of June 2, 1997.

Table 6-1. Resource Requirements

ID	Name	Process	Runs	Period	Output (GB/Day)	MFLOPS (sec.)	Staging (GB/Day)	Staged Files
PGE1	Level 1A/ Geolocation	MOD_PR01 MOD_PR03	12	2 hr.	128.55	212.30	70.20	L0
PGE2	Level 1B	MOD_PR02	288	5 min.	334.73	730.90	115.10	L1A
PGE3	Masks/Profiles	MOD_PRANC MOD_PR35 MOD_PR07 MOD_PRVOLC	288	5 min.	110.62	1168.99	446.46	L1B, GEO, ANC
PGE4	L2 Atmosphere	MOD_PR05 MOD_PR04L MOD_PR04S	144	5 min.	1.72	126.22	458.81	L1B, GEO, ANC, MOD35, MOD07
PGE5	L3 Interim Land Aerosol	MOD_PR04LA	15	99 min.	0.61	10.66	0.14	MOD04LA
PGE6	L2 Clouds	MOD_PR06CT MOD_PR06IR MOD_PR06OD	288	5 min.	7.30	205.19	451.20	L1B, GEO, ANC, MOD35
PGE7	L2 Snow	MOD_PR10	144	5 min.	1.58	2.32	352.92	L1B, GEO, MOD35
PGE8	L2 Sea Ice	MOD_PR29	144	5 min.	1.58	6.76	352.92	L1B, GEO, MOD35
PGE9	L2 Ocean Color	MOD_PR18	144	5 min.	52.30	497.75	352.92	L1B, GEO, MOD35
PGE10	L2 SST	MOD_PR28	288	5 min.	6.44	82.88	352.98	L1B, GEO MOD35, MOD38
PGE11	L2 Reflectance	MOD_PR09	288	5 min.	72.89	66.80	349.82	L1B, GEO, MOD05, MOD35
PGE12A	L2G Pointers	MOD_PRMGPNTR	384	1 day	240.12	1238.00	13.46	GEO
PGE12B	L2G Geolocation Angles	MOD_PRMGGA	384	1 day	8.10	4.89	13.46	GEO
PGE13	L2G Refl/Fire	MOD_PR09G MOD_PR14G	338	1 day	150.49	16.88	320.15	MOD09, MOD14, MODMGPNTR
PGE14	L2G Snow	MOD_PR10G	338	1 day	4.80	4.53	241.70	MOD10, MODMGPNTR
PGE15	L2G Sea Ice	MOD_PR29G	130	1 day	3.12	29.10	241.70	MOD29, MODMGPNTR
PGE16	L2 LST	MOD_PR11A	1	1 day	0.02	3.90	673.54	L1B, GEO, MOD09, MOD30, MOD35, MODMGPNTR
PGE17	L3 Ocean Color	MOD_msbin	144	5 min.	5.87	56.07	52.30	MOD18
PGE18	Ocean Products	MOD_PR27_Y	1	1 year	0.01	96.00	1.52	MOD18A2
PGE19	L3 SST	MOD_msbin	288	5 min.	1.30	76.87	6.44	MOD28
PGE20	L3 Ocean Interim Daily	MOD_mtbin	40	1 day		212.30	5.54	MOD18A1, MOD28A1

ID	Name	Process	Runs	Period	Output (GB/Day)	MFLOPS (sec.)	Staging (GB/Day)	Staged Files
PGE21	L3 Fire Daily	MOD_PR14A	338	1 day	4.49	42.01	0.02	MOD11A
PGE22	L3 BRDF/ Subset	MOD_PR43B1	338	1 day	50.94	14.25	399.34	MOD04A1, MOD09G, MOD14G, MODMGPNTNTR, MODMGGA, MOD11LSTP
PGE23	L3 BRDF/BARS	MOD_PR43B2	338	16 day	0.00	0.04	50.94	MOD43A3
PGE25	L3 VI 8 day	MOD_PR13	338	8 day				
PGE26	L3 VI 8 day CMG	MOD_PR13C	1	8 day			0.00	MOD13P
PGE27	L3 VI 16 day	MOD_PR13A	338	16 day	6.34	161.00	0.00	
PGE28	L3 VI month	MOD_PR13B	338	32 day	3.12	108.36	6.34	
PGE29	L3 Fire 8 day	MOD_PR14A	338	8 day	0.45	10.83		
PGE30	L3 Fire 16 day	MOD_PR14A	338	16 day				
PGE33	L3 LAI/FPAR Daily	MOD_PR15A1 MOD_PR15A2	338	1 day				
PGE34	L3 LAI/FPAR 8 day	MOD_PR15	338	8 day	0.50	6.90		
PGE36	NPP ancillary	MOD_PR17P	1	1 day			98.28	
PGE37	L3 NPP daily	MOD_PR17	338	8 days	0.08	0.03		
PGE40	L3 Land Cover Monthly	MOD_PR12M	338	32 day	4.40	0.03	58.41	
PGE41	L3 Land Cover Quarter	MOD_PR12Q	338	96 day	1.01	2.86	4.40	
PGE43	L3 Snow Daily	MOD_PR10A	338	1 day	8.11	4.13	248.24	MOD10G, MODMGPNTNTR
PGE44	L3 Sea Ice Daily	MOD_PR29A	130	1 day	3.12	4.49	3.12	MOD29G
PGE45	L3 Snow 10 day	MOD_PR33	338	10 day	0.80	0.36	8.11	
PGE47	L3 Sea Ice 10 day	MOD_PR42	130	10 day	0.30	0.34	3.12	
PGE49	L3 Ocean Interim Weekly	MOD_mtbin	40	8 day			0.00	
PGE50	L3 Ocean Interim 3 week	MOD_mtbin	40	8 day	0.00			
PGE51	L3 Ocean 3 week Reference	MOD_mfill	40	8 day	0.00		0.00	
PGE53	L3 Ocean Daily	MOD_mcloud	40	1 day	4.35	56.00	0.00	
PGE54	L3 Ocean Weekly	MOD_mtbin	40	8 day	1.52	0.07	4.35	
Totals:					1221.67	4332.59	1540.61	

7. ACRONYMS AND ABBREVIATIONS

CPU	Central Processing Unit
DAAC	Distributed Active Archive Center
DAO	Data Assimilation Office
DLT	Digital Linear Tape
ECS	EOSDIS Core System
EDOS	EOS Data and Operations Systems
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
GDAAC	GSFC Distributed Active Archive Center
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
L1	Level 1
L1A	Level 1A
L1B	Level 1B
L2	Level 2
L3	Level 3
L4	Level 4
LST	Land Surface Temperature
MCST	MODIS Characterization Support Team
MEBDOS	MEBS Data Ordering System
MEBS	MODIS Emergency Backup System
MODIS	Moderate Resolution Imaging Spectroradiometer
NMC	National Meteorological Center
NPP	Net Primary Production
PGE	Product Generation Executive
SDST	Science Data Support Team
SGI	Silicon Graphics Incorporated
SST	Sea Surface Temperature
TBD	To Be Determined
TLCF	Team Leader Computing Facility
TOMS	Total Ozone Mapping Spectrometer
URL	Universal Resource Locator